ARCHES NATIONAL PARK

1) Effects of Resource Availability and Food Preferences on Home Range Use and Caching Behavior of Ord's Kangaroo Rats (*Dipodomys ordii*).

Name of principal investigator: Janene Auger **Email:** auger@unr.nevada.edu

Name of institution represented: University of Nevada – Reno

Purpose of study

Food resources can affect all aspects of a species' natural history including physiology, foraging and other behaviors, space use, and population demography. In communities where food resources exhibit high between-year variation these effects may be readily observed under natural conditions. In this study I will investigate the correlation between home range size and food availability for Dipodomys ordii in a habitat dominated by a mast-seeding shrub, blackbrush (Coleogyne ramosissima). I predict that home ranges should contract under conditions of high seed abundance. I will also determine the preferences of D. ordii for various native seeds preparatory to an experiment on caching behavior. The experiment will test the notion that kangaroo rats should conform more strictly to predictions derived from theory on optimal cache spacing when they are storing a highly preferred seed than when they are storing a less preferred seed. More specifically, caches of a highly preferred seed should be small and spread out in exclusive areas of the individual=s home range, thereby reducing the risk of pilferage. Methods will include aerial photography, radio telemetry, cafeteria-style food preference trials, and flourescent powder tracking.

2) Geological Evaluation to Determine the Nature of and Recharge Area for Two Springs in Arches NP.

Name of principal investigator: James Harte **Email:** james_harte@nps.gov

Name of institution represented: National Park Service

Purpose of study

The Utah Geological Survey (UGS) herein proposes to provide information to determine (1) the recharge area(s) and geologic controls of one spring in Courthouse Wash and one spring in Sevenmile Canyon Wash (figure1), both located near the southwestern boundary of Arches National Park, and (2) whether wells used in currently existing development are completed in the

aquifer(s) supplying water to one or both of the springs.

3) Picturing National Parks

Name of principal investigator: Emily Scott **Email:** emeliza@hotmail.com

Name of institution represented: University of California - Los Angeles

Purpose of study
In an effort to broaden understanding of our relationships to nature in the late twentieth and early twenty-first centuries, I intend to investigate national park tourist culture, scenic vision, and photographic practice. Specifically, I want to study how our vision of national parks is influenced by mediated images we see before ever arriving in the parks themselves (through advertisements, film, photography, the internet, etc.) and secondly, the act of picture-taking as central to the "national park experience."

4) Faulting, Fault Zone Processes and Fluid Flow In Three Dimensional Basin Models

Name of principal investigator: Stuart Clarke **Email:** s.m.clarke@esci.keele.ac.uk

Name of institution represented: University of Keele, England

Purpose of study
To provide a three-dimensional geological model of faults in Arches NP.

5) Carbon and Nitrogen Cycles in Arid Lands: The Role of Biological Soil Crusts as Influenced by Soil Surface Disturbance, Climate Change and Annual Grass Invasion

Name of principal investigator: Jayne Belnap **Email:** jayne_belnap@usgs.gov

Name of institution represented: U.S. Geological Survey

Purpose of study

Models indicate the presence of a large carbon (C) sink at temperate latitudes in the northern hemisphere. Over thirty percent of lands both globally and in the United States consist of semi-arid or arid landscapes. Very little is known about carbon dynamics in these regions. Biological soil crusts, composed primarily of cyanobacteria, algae, lichens and mosses, can completely cover plant interspaces in undisturbed areas, and constitute 70 percent or more of the living ground cover. These soil crusts can be the dominant source of nitrogen (N) for vascular plants. They fix C at a high rate and are critical for soil stability and aggregate formation, which is important in C storage. They also absorb significant amounts of CH_4. In areas where precipitation is low and soils have low fertility, native plants often rely on intact biological soil crusts to provide increased water and nutrient flow to the broadly scattered vegetation. Thus, there are many ways in which biological soil crusts influence biogeochemical cycles and the structure and productivity of the vascular plant community.

Soil surface disturbance, invasive plants, and climate change have the potential to dramatically alter the structure and function of biological soil crusts. The current combination of recreational use and livestock grazing is resulting in unprecedented levels of surface disturbance on many arid lands. In regions that did not have substantial amounts of surface disturbance in the Holocene, biological soil crusts disappear readily when trampled by animals or vehicles. Exotic annual grasses are invading many of these areas. Trampling and invasion results in reduced cover and changes in the species composition of biological soil crusts. This, in turn, leads to changes in processes such as decomposition, N and C fluxes, soil moisture, and nutrient availability to vascular plants. Decreases of only 1 percent of soil organic carbon in the top 10 cm of rangeland soils is equivalent to the total C emissions from all croplands nation-wide.

Changes in climate regimes, such as a shift in the summer monsoonal boundaries in the western United States, are expected to influence the composition and physiological functioning of biological soil crusts. Various crust components have different photosynthetic and respiration responses to temperature and moisture. In addition, different crusts have different methane fluxes. Therefore, changes in the timing or amount of temperature and precipitation is expected to alter soil C and N fluxes through changes in physiological response or crustal composition. This, in turn, can significantly impact vascular plant productivity.

This project will establish how alterations in species composition by surface disturbance, invasive grasses, and/or climate change may affect N and C inputs and fluxes, in different soils under different climatic regimes. Because current and expected changes in land use and climate will occur over millions of acres in western rangelands, impacts to soil crusts have the potential for dramatically affecting C cycles, N cycles, and vascular plant productivity over much of the western United States. In addition, semi-arid and arid ecosystems represent over one-third of the Earth's terrestrial surface, and most are covered by biological soil crusts. As human impacts are escalating both regionally and globally in these drier regions, the research questions posed in this proposal have significant implications for global C budgets as well.

6) GypsES West: Providing Phenologically Based Decision Support for Timing Effective Management Actions.

Name: Steve Munson **Email:** smunson@fs.fed.us

Name of institution represented: USDA FOREST SERVICE

Purpose of study
The models and decision support tools that will be developed from this project will facilitate the most efficacious gypsy moth control/eradication programs within the Intermountain west with the least possible impacts on non-target organisms. The project has 3 major objectives:
1. Validate improved egg hatch and larval phenology models.
2. Produce validated decision support tools for field application within western regional climates.
3. Evaluate probability of gypsy moth establishment in Utah which includes the production of probability of establishment maps. The probability of establishment maps will produce categories of risk for all vegetative types associated with various elevations within the state of Utah.

7) Trassic Pre-Dinosaurian Communities National Park's Land, The Oldest Megatracksite In North America

Name of principal investigator: Debra Mickelson **Email:** mickelsd@ucsu.colorado.edu

Name of institution represented: University of Colorado - Boulder

Purpose of study
Document the three-dimensional size and shape of the tracks exposed on fallen blocks and on the undersides of track bearing units of the Moenkopi Formation. And to identify important invertebrate and plant trace fossils found to occur in association with vertebrate swim tracks and footprints

8) Survey of Dinosaur Tracks, Arches National Park

Name of prin. investigator: Martin Lockley **Email:** Mlockley@Carbon.CUDenver.edu

Name of institution represented: University of Colorado - Denver

Purpose of study
This is a follow up to the NPS Paleontological Survey conducted in the year 2000 under the guidance of by Vince Santucci (NPS) and Jim Kirkland (Utah State Geologist). In essence we have been encouraged to follow up by documenting

tracks found during this survey last year.

9) Visions of a Sculptured Paradise: The Colorado Plateau as American Sacred Space.

Name of prin. investigator: Sam Schmiedling **Email:** ecolage@phnx.uswest.net

Name of institution represented: Arizona State University

Purpose of study:
A region-wide study of the Colorado Plateau

10) Faulting, Fault Zone Processes & Fluid Flow In Three Dimensional Basin Models

Name of prin. investigator: Stuart Clarke **Email:** stu.clarke@virgin.net

Name of institution represented: Keele University, United Kingdom

Purpose of study:
Faults are key controlling elements in fluid flow systems in sedimentary basins. When faults undergo displacement, they change their fluid transmissibility properties by juxtaposing varying lithologies across the fault, by pumping or valving diagenetic fluids, and by smearing semi-permeable or impermeable clays and shales within fault zones.

Three-dimensional sequential modelling of fault displacement has enabled the building of earth models with time-varying structural geometries. Based on the geometries of strata that are cut by faults, their juxtaposition relationships and their physical properties, various cross fault relationships have been modelled in three-dimensional space. Structural restoration, or retro-deformation provides 'snapshots' of fault and stratal geometries through time. These are used in forward modelling from the undeformed state of the rock volume to its present-day structural architecture. The evolution of cross fault relationships is dynamically calculated and forward modelling allows a prediction of the development of fault zone smears, gouges and cataclasis.

Cross fault juxtaposition of strata and fault zone processes such as smearing and cataclasis have been incorporated into three-dimensional transmissibility models involving invasion percolation (IP). The effects fault zone processes on fluid flow are incorporated into four-dimensional forward models which, through the IP algorithm, calculate hydrocarbon fluid flow pathways controlled by lithology (transmissibility distribution) and structural geometries in rock volumes. The controls of fluid flow by lithology distribution and variations in cross-fault sealing capacity have been modelled both spatially and with time.

11) Triassic Pre-Dinosaurian Communities National Park's Land, The Oldest Megatracksite In North America

Name of principal investigator: Debra Mickelson **Email:** mickelsd@ucsu.colorado.edu

Name of institution represented: University of Colorado - Boulder

Purpose of study

During the summer of 2000, tetrapod tracks were observed on fallen blocks and in situ host beds of Early/Middle? Triassic Moenkopi Formation (Torrey Member) in remote washes at Capitol Reef National Park, Glen Canyon National Recreational Area. Lateral correlations of the track bearing horizons are extensive and have been traced to BLM and private land's adjacent to Arches and Canyonlands National Park's. For that reseason the possiblity of lateral correlations of tracing these track bearing horizons within the Park's boundaries is essential. Most of the tracks are the typical and common "swim tracks" observed and documented previously from the Moenkopi Formation in Western North America. However, in addition to swim tracks of (Chirotherium), new terrestrial "walking" vertebrate footprints have been found in association with invertrbrates and plant trace fossils. Rare, fish fin drag marks (Undichnia) have been identified with swim tracks of small lizard-like (Rhynchosauroides) and (Chirotherium).

The research proposed here will be conducted to document the three dimensional size and shape of the tracks exposed on fallen blocks and on the undersides of track bearing units. Also to identify important invertebrate and plant trace fossils found to occur in association with vertebrate swim tracks and footprints. Latex molds and casts of the tracks will be collected to further document the tracks and permit later construction of plaster casts in a laboratory. Latex molds and casts do not damage the tracks or the host bed surfaces, and the tracks themselves will be left in place. Selected footprints and trackways will be traced using Duralar (.003 clear plastics). The footprints will be photographed extensively. Park Service personnel will be made aware of the exact location of the tracks and invited to participate in any or all aspects of the study.

To place the tracks within a stratigraphic framework, the research team will determine the source of the fallen blocks and investigate, in situ, host beds. Because of the high density of tracks observed on the fallen blocks, it is likely that additional tracks will be found in place and aid in the identification and lateral extension of the host beds. Measured stratigraphic sections will be constructed to document the locations of the trackways.

To understand the paleoecology of the trackmakers the research team will observe, photograph, and in some cases, collect rock samples and/or plant material and invertebrate trace or body fossils (surface collecting only) from stratigraphic units containing and surrounding the tracks and trackways. (No

vertebrate tracks will be collected). The lithologys and depositional environments of the host beds and the surrounding units will be determined.
Because fossils are rare from the Early/Middle? Triassic in the Western United States, these vertebrate tracksites could contribute important information about the early evolution of pre-dinosaurian communities and the environments in which they lived.